Properties of Prudhoe Bay (2004) (ESTS #679)

Origin: Alaska, USA

Physical Properties

% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%
Density (g/mL) - ASTM D5002				
T=15℃	0.8947	0.9112	0.9235	0.9336
σ				
T=0℃	0.9096	0.9241	0.9365	0.9468
T=5℃	0.9026	0.9190	0.9313	0.9413
σ				
Calculated API gravity	25.9	23.2	21.2	19.6
Dynamic Viscosity (mPa·s)				
T=15℃				
	38.9	103	318	865
σ				
T=0℃				
T=5℃	78.7	301	γ=1: 3300, γ=10: 1570, γ=100: 840	γ=1:1.05E+04, γ=10: 4510, γ=100: 2160
σ				
Method	ESTS 2003	ESTS 2003	ESTS 2003	ESTS 2003
Surface/Interfacial Tension (mN/m or dynes/cm)				
oil-air, T=15℃	28.7	29.8	30.8	Too Viscous
σ	0.1	0.0	0.0	
oil-water - T=15℃	31.3	25.2	24.5	Too Viscous
σ	0.5	0.5	0.5	
oil-salt water (33‰ NaCl), T=15℃	28.1	23.8	22.4	Too Viscous
σ	0.4	0.1	1.3	
oil-air, T=0℃				
oil-air, T=5℃	29.2	28.6		
σ	0.1	0.3		
oil-water, T=0℃				
oil-water, T=5℃	28.6	26.2		
σ	0.7	0.5		
oil-salt water (33‰ NaCl), T=0℃				
oil-salt water (33‰ NaCl), T=5℃				
σ				
Method	ASTM D971 m.	ASTM D971 m.	ASTM D971 m.	ASTM D971 m.

T=temperature; σ = standard deviation; γ=shear rate (s^{-1}); m.=modified

Prudhoe Bay (2004) (ESTS #679)

% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%

Flash Point

Flash point (℃)
σ
Method

Pour Point

Pour point (℃)
σ
Method

Boiling Point

N/A
Method

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Prudhoe Bay (2004) (ESTS #679)

% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%

Fate and Behaviour Properties

Adhesion - ESTS 1996

Adhesion (g/m^2)
σ

Chemical Disperibility with Corexit 9500 Dispersant (Swirling Flask Test) - ASTM F2059

Dispersant effectiveness (%)	54
σ	2.8

Evaporation Equation - ESTS 1998-1

% mass loss of **fresh** oil after time t (min) at temperature T (°C)
N/A

Emulsions (day of formation - 15°C) - ESTS 1998-2

Visual stability
Complex Modulus (Pa)
σ
Storage Modulus (Pa)
σ
Loss Modulus (Pa)
σ
tan delta (V/E)
σ
Complex viscosity (Pa.s)
σ
Water content (%w/w)
σ

Emulsions (week after formation - 15°C) - ESTS 1998

Visual stability
Complex Modulus (Pa)
σ
Storage Modulus (Pa)
σ
Loss Modulus (Pa)
σ
tan delta (V/E)
σ
Complex viscosity (Pa.s)
σ
Water content (%w/w)
σ

T=temperature; σ = standard deviation; γ=shear rate (s^{-1}); m.=modified

Prudhoe Bay (2004) (ESTS #679)

Chemical Properties

% Evaporative Mass Loss	0.0%	6.3%	0.131	0.197
Sulfur Content - ASTM D4294				
Sulfur content (%)				
σ				
Water Content - ASTM E203				
Water content (%)				
σ				
BTEX groups (µg/g)-ESTS 2002b				
Benzene	2189	595	12	0
Toluene	6204	3887	52	0
Ethylbenzene	1550	1205	184	0
m&p-Xylene	4598	4013	775	0
o-Xylene	1857	1664	425	0
Isopropylbenzene	393	362	131	0
Propylebenzene	759	762	362	2
3&4-Ethyltoluene	1739	1668	891	10
1,3,5-Trimethylbenzene	926	904	530	10
2-Ethyltoluene	720	698	416	9
1,2,4-Trimethylbenzene	1603	1579	1056	43
1,2,3-Trimethylbenzene	250	246	164	7
C4-C6 alkyl benzenes (µg/g)-ESTS 2002b				
Isobutylbenzene	49	62	32	1
1-Methyl-2-isopropylbenzene	48	128	35	3
1,2-Dimethyl-4-ethylbenzene	358	360	318	73
Amylbenzene	97	97	93	34
n-Hexylbenzene	86	88	92	67
Headspace analysis (mg/g oil)-ESTS 2002b				
n-C5	33.7	0.32	0.00	
n-C6	19.1	2.09	0.00	
n-C7	6.76	2.72	0.00	
n-C8	3.17	2.21	0.12	0.00
C5 group	94.8	0.48	0.00	
C6 group	95.9	16.23	0.00	
C7 group	30.7	15.93	0.00	
Hydrocarbon content ratios-ESTS 2002a				
GC-TPH	549	578	595	561
GC-TSH				
GC-TAH				
GC-TSH/GC-TPH (%)	68	69	68	68
GC-TAH/GC-TPH (%)	32	31	32	32
GC Resolved Peaks/TPH (%)	22	19	17	16

GC: Gas Chromatography; TPH:Total petroleum hydrocarbon; TAH: Total saturate hydrocarbon; TAH: Total aromatic hydrocarbon

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Prudhoe Bay (2004) (ESTS #679)

% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%
CCME (mg/g oil)-ESTS 2002a				
F1	49	37	15	1
F2	134	130	146	113
F3	302	334	354	370
F4	64	78	81	77
Saturates (F1)-ESTS 2002a				
n-C8 to n-C10				
n-C10 to n-C12				
n-C12 to n-C16				
n-C16 to n-C20				
n-C20 to n-C24				
n-C24 to n-C28				
n-C28 to n-C34				
n-C34+				
Aromatics (F2)-ESTS 2002a				
n-C8 to n-C10				
n-C10 to n-C12				
n-C12 to n-C16				
n-C16 to n-C20				
n-C20 to n-C24				
n-C24 to n-C28				
n-C28 to n-C34				
n-C34+				
GC-TPH (F1 +F2)-ESTS 2002a				
n-C8 to n-C10				
n-C10 to n-C12				
n-C12 to n-C16				
n-C16 to n-C20				
n-C20 to n-C24				
n-C24 to n-C28				
n-C28 to n-C34				
n-C34+				
TOTAL TPH (GC detected + undetected TPH)				
	61	**60**	**59**	**54**
Hydrocarbon group content - ESTS 2003				
Saturates (%)	61	60	59	54
Aromatics (%)	28	28	27	25
Resin (%)	8	8	10	16
σ	0	0	0	2
Ashphaltene (%)	3	4	4	5
σ	0.0	0.1	0.1	0.1

Wax content - ESTS 1994
Waxes (%)
σ

Prudhoe Bay (2004) (ESTS #679)

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% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%
n-Alkanes (µg/g oil)-ESTS 2002a				
C8	3172	2207	117	0
C9	3525	3296	1127	0
C10	3558	3360	2523	104
C11	3838	3907	3957	1098
C12	3767	4011	4370	2657
C13	3637	3976	4448	3764
C14	3493	3753	4344	3791
C15	3503	3748	4126	4082
C16	3061	3353	3942	3992
C17	3074	3323	3699	3776
Pristane	1858	2013	2236	2269
C18	2744	2930	3293	3379
Phytane	1417	1519	1699	1735
C19	2424	2530	2837	2902
C20	2359	2506	2750	2879
C21	2152	2348	2639	2668
C22	2053	2255	2531	2589
C23	1945	2077	2330	2386
C24	1857	1969	2201	2220
C25	1665	1777	1931	1986
C26	1653	1751	1903	1956
C27	1212	1282	1405	1491
C28	1005	1009	1152	1170
C29	786	890	960	1006
C30	615	676	725	759
C31	500	568	611	647
C32	377	450	486	542
C33	374	433	448	477
C34	328	358	401	430
C35	266	345	381	405
C36	164	197	218	247
C37	128	169	193	209
C38	124	155	172	188
C39	86	114	160	172
C40	77	99	117	148
C41	55	73	76	113
C42	46	58	67	86
C43	36	47	56	69
C44	29	37	46	47

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Prudhoe Bay (2004) (ESTS #679)

% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%
Alkylated Total Aromatic Hydrocarbons (PAHs) (µg/g oil)-ESTS 2002a				
Naphthalene				
C0-N	654	670	725	365
C1-N	2187	2211	2527	1939
C2-N	3091	3099	3570	3194
C3-N	2623	2650	3020	2901
C4-N	1601	1635	1743	1822
Phenanthrene				
C0-P	327	335	372	376
C1-P	865	908	1002	1025
C2-P	1036	1075	1158	1221
C3-P	887	930	997	1028
C4-P	579	592	635	668
Dibenzothiophene				
C0-D	223	233	252	260
C1-D	422	445	485	496
C2-D	654	698	749	777
C3-D	529	561	602	640
Fluorene				
C0-F	95	97	106	107
C1-F	251	267	283	292
C2-F	405	439	458	479
C3-F	438	475	485	507
Benzonaphthothiophene				
C0-B				
C1-B				
C2-B				
C3-B				
C4-B				
Chrysene				
C0-C	56	61	65	68
C1-C	92	98	113	122
C2-C	138	146	153	160
C3-C	113	122	131	137

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Prudhoe Bay (2004) (ESTS #679)

% Evaporative Mass Loss	0.0%	6.3%	13.1%	19.7%
Other Priority PAHs (µg/g oil)				
Biphenyl (Bph)	177	194	214	188
Acenaphthylene (Acl)	18	19	20	21
Acenaphthene (Ace)	15	16	17	18
Anthracene (An)	3	3	3	3
Fluoranthene (Fl)	3	4	4	4
Pyrene (Py)	13	14	15	15
Benz(a)anthracene (BaA)	4	4	4	4
Benzo(b)fluoranthene (BbF)	10	10	10	10
Benzo(k)fluoranthene (BkF)	0	1	1	1
Benzo(e)pyrene (BeP)	14	16	17	18
Benzo(a)pyrene (BaP)	2	2	2	2
Perylene (Pe)	1	1	1	1
Indeno(1,2,3-cd)pyrene (IP)	0	0	0	0
Dibenzo(ah)anthracene (DA)	1	1	1	1
Benzo(ghi)perylene (BgP)	4	4	4	4

Biomarkers (µg/g oil)-ESTS 2002a
C21 tricyclic terpane (C21T)
C22 tricyclic terpane (C22T)
C23 tricyclic terpane (C23T)
C24 tricyclic terpane (C24T)
30-Norhopane(H29)
Hopane (H30)
30-Homohopane-22S(H31S)
30-Homohopane-22R(H31R)
30,31-Bishomohopane-22S(H32S)
30,31-Bishomohopane-22R(H32R)
30,31-Trishomohopane-22S(H33S)
30,31-Trishomohopane-22R(H33R)
Tetrakishomohopane-22S(H34S)
Tetrakishomohopane-22R(H34R)
Pentakishomohopane-22S(H35S)
Pentakishomohopane-22R(H35R)
18α,22,29,30-trisnorneohopane (C27Ts)
17α(H)-22,29,30-Trisnorhopane (C27Tm)
14ß(H),17ß(H)-20-Cholestane(C27αßß)
14ß(H),17ß(H)-20-Methylcholestane(C28αßß)
14ß(H),17ß(H)-20-Ethylcholestane(C29αßß)

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